J. Raptor Res. 24(1-2):19-25
© 1990 The Raptor Research Foundation, Inc.

ROOST-TREE CHARACTERISTICS, FOOD HABITS AND SEASONAL ABUNDANCE OF ROOSTING EGYPTIAN VULTURES IN NORTHERN SPAIN

OLGA CEBALLOS[1]
Sociedad de Ciencias Aranzadi, Pl. I. Zuloaga (Museo), 20003 San Sebastian, Spain

JOSE A. DONÁZAR
Estación Biológica de Doñana, CSIC, Pabellón del Perú, Avda. Mª Luisa s.n., 41013 Sevilla, Spain

ABSTRACT.—Six Egyptian Vulture (*Neophron percnopterus*) communal roosts were discovered in northern Spain between 1986–1988. The maximum number of Egyptian Vultures observed varied between 8 and 138 ($\bar{x}$ = 55). Vultures generally selected large, dead trees for roosting, and foraged primarily on domestic mammals and birds, wild lagomorphs and garbage. In 1988 the largest roost was formed in late February and dissolved in early September. Number of vultures peaked in late July; 72.6% of the vultures observed were adults, 26.6% immatures and 0.8% juveniles. Immatures frequented roosts between May and September. Juveniles were observed in August and September.

Caracteristicas de los árboles dormideros, hábitos de alimentación y abundancia estacional de dormideros de buitres egipcios en el norte de España

EXTRACTO.—Seis dormideros comunales de buitres egipcios (*Nephron percnopterus*) han sido descubiertos en el norte de España, entre 1986–1988. El máximo número de buitres egipcios observados variaba entre 8 y 138 ($\bar{x}$ = 55). Los buitres generalmente seleccionaban grandes árboles muertos para dormideros, y se alimentaban principalmente de mamíferos y aves domésticos, liebres y basura. En 1988, el dormidero más grande ha sido formado a fines de febrero, y desocupado a principios de setiembre. El número de buitres ha alcanzado su máximo a fines de julio. 72.6% de los buitres observados han sido adultos, 26.6% han sido aun inmaduros, y 0.8% en estado juvenal. Los buitres inmaduros frecuentaban dormideros entre mayo y septiembre. Los buitres en estado juvenil han sido observados en agosto y septiembre.

[Traducción de Eudoxio Paredes-Ruiz]

Egyptian Vultures (*Neophron percnopterus*), like some other Old and New World vultures, congregate in communal roosts. Roosts have been reported throughout the entire range of the species (Brown and Amadon 1968, Cramp and Simmons 1980) though rarely occurring in the Western Palearctic. Cramp and Simmons (1980) pointed out roosts during the 1800s in Istanbul and early 1900s in the south of Spain and the Macaronesian Islands. More recently, after decline of the species in Europe, the only reported roosts are located on the Mediterranean island of Menorca (Congost and Muntaner 1974), where up to 47 Egyptian Vultures have been counted roosting on cliffs and in pine trees. However, recent reports provide only anecdotal information, and detailed monitoring of Egyptian Vulture roosting behavior is lacking. Here we describe tree characteristics, food habits, and dynamics (seasonal changes in abundance) of spring–summer Egyptian Vulture communal roosts in northern Spain.

STUDY AREA AND METHODS

The study was carried out from 1986–1988 in a 13 000 km² area covering the left bank of the upper valley of the Ebro River (northern Spain), including parts of the provinces of Navarra, Huesca and Zaragoza. Climate is influenced by the Pyrenees Mountain range which receives rain from the northwest. Unequal rainfall occurs in the Pyrenees (>2000 mm/yr) and in the Ebro valley (<400 mm/yr). Vegetation in the Pyrenees is predominantly forest [Scots pine (*Pinus sylvestrys*), beech (*Fagus sylvayica*) and oak (*Quercus* spp.)] while in the Ebro valley herbaceous pseudosteppe vegetation and cereal cultures predominate.

[1] Present address: Grupo de Estudios Biológicos UGARRA, C. Carlos III 19-4, 31002 Pamplona, Spain.

Table 1. Characteristics of Egyptian Vulture roosts. The number of checks and the information (number of Egyptian Vultures, date, % immatures) obtained from the checks when a large number of birds was seen is detailed. For other species seen regularly the maximum number observed is detailed.

	ROOST					
	1	2	3	4	5	6
Substrate	Pines[a]	Pines[b]	Pines[c]	White poplar	Cliff	Pines[a]
Number of checks	42	10	8	2	14	4
Max. no. Egypt. Vult.	138	43	52	72	14	8
Date	29 July 1988	29 July 1988	15 July 1987	6 July 1988	7 July 1987	7 July 1987
% immatures	27.5	18.6	19.6	28.3	5.1	25.0
Other species						
Griffon Vulture	210	—	—	—	26	—
Black Kite	70	—	—	—	—	—
Red Kite	25	8	3	—	—	—
Raven	100	—	60	—	—	—

[a] *Pinus halepensis*, [b] = *P. sylvestris*, [c] = *P. nigra*.

Roost tree characteristics were studied in 4 large roosts using comparisons with control trees. Roost trees were considered to be those under which Egyptian Vulture droppings, feathers and pellets could be found simultaneously. Control trees were chosen by random selection in the roost area. All trees with a diameter at breast height (DBH) >15 cm were included in the analysis. The following 5 variables were evaluated for each roost and control tree:

1) Maximum DBH (cm);
2) Height (m) measured with optical instruments;
3) Number of trees (>15 cm DBH) in a 10 m radius;
4) Foliage cover (classified on a scale of 1 to 5; a value of 1 represented a tree with green leaves on every branch and a value of 5 represented a defoliated (dead) tree),
5) Percentage of open space around the maximum diameter of the crown of the tree. Closed space is taken to be when the crowns of neighboring trees were closer than 2 m to that of the tree measured.

Values for roost and control trees were compared by Mann-Whitney *U*-tests (Siegel 1956).

Food habits were studied in the 4 largest roosts by analyzing pellets collected from beneath the roost trees during September 1988. Bones, hair and feathers obtained

Table 2. Comparison between the characteristics of roost (r) and control (c) trees in each of 4 main roosts. In roost 1, the 3 nuclei (A, B, and C) have been considered separately. Mean, standard deviation (parentheses) and significance of the differences for each variable are shown (Mann-Whitney *U*-tests).

	ROOSTS											
	1 A		1 B		1 C		2		3		4	
	R N = 5	C N = 5	R N = 6	C N = 6	R N = 5	C N = 5	R N = 9	C N = 12	R N = 6	C N = 8	R N = 13	C N = 7
1) Diameter (cm)	43.2 (12.2)	40.0 (9.0)	34.3 (5.7)	26.2[a] (3.3)	36.0 (9.1)	41.6 (12.1)	23.1 (2.5)	22.2 (2.5)	40.2 (6.3)	31.0[b] (5.7)	45.6 (12.1)	29.0[b] (9.6)
2) Height (m)	6.5 (2.2)	8.3 (1.9)	10.1 (1.4)	9.0 (1.3)	6.4 (1.1)	5.4 (1.3)	14.9 (0.3)	15.0 (0.0)	15.3 (1.8)	11.9[a] (2.6)	10.0 (2.4)	6.7 (1.1)
3) Number of trees	0.6 (0.6)	1.6[a] (1.8)	3.2 (1.5)	6.3[b] (2.2)	1.0 (0.7)	3.8[a] (2.3)	11.3 (2.2)	15.6[b] (2.6)	5.0 (2.4)	4.5 (3.3)	1.6 (1.0)	1.1 (0.9)
4) Foliage (1–5)	5.0 (0.0)	1.8[b] (0.8)	2.7 (0.8)	2.7 (0.8)	4.8 (0.5)	1.4[b] (0.6)	2.1 (0.3)	2.0 (0.0)	2.7 (0.8)	1.8 (0.5)	2.6 (1.0)	2.6 (1.3)
5) Open space (%)	94.0 (13.4)	77.0 (22.8)	53.3 (12.1)	45.8 (31.7)	96.0 (8.9)	62.0[a] (29.7)	60.6 (12.1)	22.9[c] (18.6)	72.5 (14.8)	71.9 (23.0)	73.9 (21.4)	87.0 (15.0)

[a] $P < 0.05$; [b] $P < 0.01$; [c] $P < 0.001$.

from pellets were classified by comparison with collections and occasionally by consulting identification keys (Faliu et al. 1980, Pinto 1980). Most of the Egyptian Vulture's food comes from carrion which is difficult to quantify. For this reason, we decided to estimate only frequencies of appearance/pellet (number of occurrences × 100/total number of pellets) and not to calculate numeric and biomass frequencies.

Seasonal changes in number of roosting Egyptian Vultures were studied in the roost where the largest number of birds were present. We conducted counts weekly from the end of February to the end of September 1988. Counts were made at the end of the day by 2–3 observers working in such a way that the whole roost could be covered simultaneously. In other species of roosting vultures (Cathartidae), counts are done on birds departing from the roost in the early morning due to difficulty in conducting observations in trees with dense foliage (Sweeney and Fraser 1986). Egyptian Vultures, however, roost in trees with little foliage or, as often happens, in dead trees. Thus, determining numbers in the evening before darkness was relatively easy. Three age classes (juvenile, immature and adult) were distinguished by differences in plumage coloration (see Porter et al. 1974, Cramp and Simmons 1980). Telescopes (20–90×) were used in all observations at distances ranging between 200 and 500 m.

RESULTS

Description of Roosts and Tree Characteristics. Six Egyptian Vulture communal roosts were located. General roost characteristics are described in Table 1. Four roosts were in pine trees, 1 in European white poplar (*Populus alba*), and 1 on a clay cliff. The maximum number of Egyptian Vultures observed in each roost was highly variable (max = 138; min = 8). Percentage of birds in immature plumage was relatively similar between roosts (19.6–28.3%). Griffon Vultures (*Gyps fulvus*), Red Kites (*Milvus milvus*), Black Kites (*M. migrans*) and Common Ravens (*Corvus corax*) were observed roosting regularly with Egyptian Vultures. Occasionally, individual birds of other species were also seen roosting [i.e., Booted Eagle (*Hieraaëtus pennatus*), Honey Buzzard (*Pernis apivorus*), Peregrine Falcon (*Falco peregrinus*) and Jackdaw (*Corvus monedula*)]. In all roosts Egyptian Vultures perched together except in the case of roost 1 which was composed of 3 separate nuclei at an average distance of 1210 m. Egyptian Vultures roosted indiscriminately in the 3 nuclei. Changes seemed to depend on weather and human disturbance (Donázar and Ceballos 1987).

Differences observed among roosts with respect to tree-selection (Table 2) might simply be a result of different characteristics in a given woodlot. In roosts 1B, 2, 3 and 4, homogeneity of the trees was noticeable, and differences between roost and control trees were necessarily small. In these roosts, birds chose trees for roosting with a large basal diameter. Roost 2 consisted of planted pine, and vultures roosted in trees along the border of the forest. Vultures strongly preferred isolated dead trees wherever available (roosts 1A and 1C).

Table 3. Results of pellet analysis of roosting Egyptian Vultures (values represent frequency of appearance per pellet).

	Roost			
	1	2	3	4
Mammals				
Oryctolagus cuniculus (wild)	42.4	16.7	4.1	19.1
Unidentified rodent	—	1.5	4.1	3.2
Felis catus	—	1.5	6.1	—
Canis familiaris	1.7	—	4.1	6.4
Meles meles	—	1.5	—	—
Vulpes vulpes	1.7	—	—	—
Equus caballus	—	—	2.0	—
Sus scrofa (domestic)	33.9	47.0	8.2	20.6
Sus scrofa (wild)	—	3.0	4.1	—
Bos taurus	1.7	7.6	14.3	4.8
Ovis aries	20.3	50.0	73.5	22.2
Capra hircus	—	1.5	—	—
Unidentified mammal	8.5	1.5	2.0	1.6
Birds				
Gallus gallus	54.2	25.8	10.2	95.2
Corvus monedula	—	—	2.0	—
Unidentified Corvidae	1.7	4.6	—	1.6
Unidentified birds	3.4	3.0	—	6.4
Reptiles				
Lacerta lepida	1.7	—	—	—
Fishes				
Unidentified fishes	—	—	—	1.6
Invertebrates				
Coleoptera	22.0	6.1	8.2	14.3
Garbage (synthetic materials)	3.4	9.1	51.0	1.6
Plant matter	47.5	48.5	24.5	27.0
Number of pellets	59	66	49	63

Food Habits. Food of roosting Egyptian Vultures was extremely varied (Table 3). A few species were represented in most of the pellets: European Rabbit (*Oryctolagus cuniculus*), pig (*Sus scrofa domestica*),

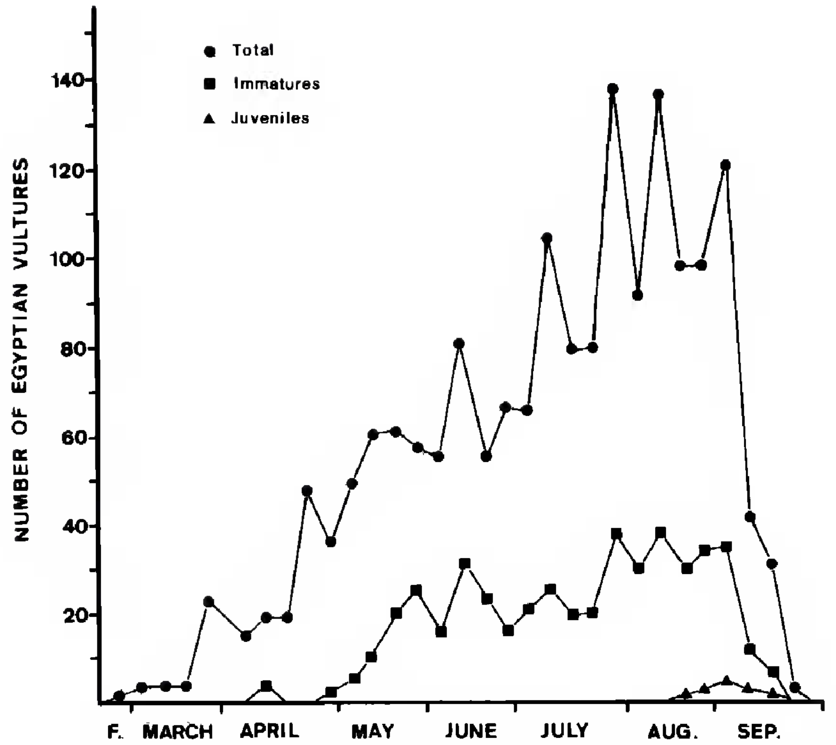

Figure 1. Number of Egyptian Vultures observed in roost 1 during 1988.

sheep (*Ovis aries*) and Domestic Fowl (*Gallus gallus*). Dominant prey remains in pellets varied from one roost to another and seemed a simple consequence of availability of food. Thus, in roosts 1 and 4, food was based on fowl raised on nearby farms. In roost 1, wild rabbits, which were abundant in the area, also entered in the diet. In roost 2 a pig slaughter house provided most of the food, and in roost 3, vultures foraged in a garbage dump containing remains of slaughtered sheep. A high frequency of plant matter in pellets cannot be accidental, given that plant material dominated in most pellets in which it appeared. Generally, plant remains consisted of stems and seeds of wild and cultivated grains as well as fruit seeds (cherry, melon and watermelon). The largest quantities of plant material appeared to be associated with hair and wool, suggesting that vultures ingest plant matter to aid in pellet formation.

Roost Seasonal Dynamics. Results of weekly counts in roost 1 are summarized in Figure 1. Vultures first arrived the last week of February. Numbers increased progressively, reaching a maximum in July–August, after which numbers dropped until the end of September when the last birds left. Although overall tendencies were constant, there were strong weekly fluctuations. A total of 1757 vultures were observed during 1988; 1275 (72.6%) adults, 468 (26.6%) immatures and 14 (0.8%) juveniles. Throughout the study period there were adult Egyptian Vultures in the roost. Birds in immature plum-

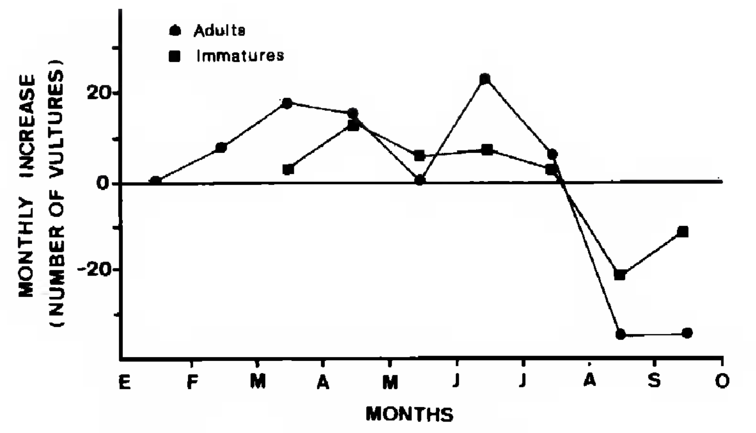

Figure 2. Monthly changes (number of vultures) in roost 1 during 1988. Changes are differences between monthly mean numbers of birds.

age, however, were not recruited until April–May. Between May and September immatures constituted a large part of the total number of birds (monthly average = 38.4%). Immigration rate of adults and immature birds differed noticeably throughout the study period (Fig. 2). Adults increase sharply from March–April and June–July, while immatures increased most sharply in the first 2 months of their appearance in the roost (May–June). Consequently, the ratio of adults to immatures varied substantially during the year (Fig. 3). With the arrival of the first immatures, the number of adults per immature dropped noticeably, gradually recovering later with the arrival of new adults. Juvenile Egyptian Vultures (hatched in 1988) frequented the roost in the last weeks of August and the first weeks of September (Fig. 1). Juveniles and immatures left the roost 2 wk before adults.

Discussion

Roost and Tree Characteristics. As in other parts of the Palearctic (see Cramp and Simmons 1980)

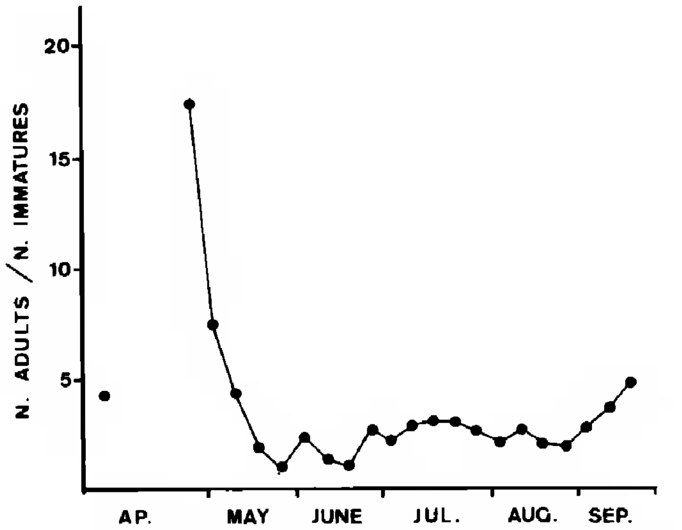

Figure 3. Ratio of adults/immatures in roost 1 during 1988.

the Egyptian Vulture preferentially chose trees for roosting in our study area. The choice of pines for roosting may only be a consequence of abundance in the study area and of the fact that pines in Spain reach taller heights than broad-leafed trees. Associated avian species observed in roosts were mainly carrion-eaters, which supports the opinion that mixed roosts may have a function related to transfer of foraging information (Ward and Zahavi 1973, but see Bayer 1982). However, species did not scavenge frequently together in the study area and usually occupied separate zones in the roosts.

Observed tendencies in tree-selection suggest that trees are chosen on the basis of 2 fundamental factors: 1) size of the tree (basal diameter) which is necessary for supporting several birds at a time; and 2) ability to enter and leave without the foliage of the roost tree and neighboring trees getting in the way (tendency to choose dead, isolated trees with an open crown). Roosting New World vultures and large eagles have also been reported to show a preference for large trees with easy access (Wright et al. 1986, Isaacs and Anthony 1987). Wright et al. (1986), however, indicated that wintering Black (*Coragyps atratus*) and Turkey Vultures (*Cathartes aura*) choose trees with abundant foliage (conifers) which provide a favorable microclimate. This is not the case with the Egyptian Vulture, which tends to choose trees without foliage probably because its roosts are in warm areas and form during warm seasons.

Food Habits. Roosting Egyptian Vulture food is, in general, similar to that of breeding pairs in the study area (see Donázar and Ceballos 1988) and reflects the great foraging eclecticism of the species (Bergier and Cheylan 1980, Cramp and Simmons 1980). In each roost, food habits seem to reflect accurately the availability of different kinds of carrion in feeding grounds nearest to roosts. This was also indicated by a radiotracking study of 3 Egyptian Vultures (2 adults; 1 immature) frequenting roosts 1 and 3 (Donázar and Ceballos 1987). The appearance of plant matter in pellets is also known in other Old World species, such as Griffon Vultures which ingest large portions of carrion without hair or feathers (pers. obs.) and has also been reported in Cathartidae (Paterson 1984, Iñigo 1987). The appearance of fruit seeds in pellets also suggests that vultures may exploit some resources that can be easily found in garbage dumps. Frequent consumption of tropical fruits has been reported for Black Vultures in Mexico (Iñigo 1987). Finally, the ingestion of plastic and synthetic materials might be explained for one of a variety of reasons: mistaken for bone fragments (Mundy 1982), as an aid to pellet formation, or ingested accidentally when vultures eat food placed inside plastic bags (Iñigo 1987).

Roost Seasonal Dynamics. Progressive increase in the total number of Egyptian Vultures in the study area may only be a consequence of greater availability of food during summer. In July, August and September the items most frequently consumed (hen, pig and wild rabbit) undergo a higher death rate than in winter and spring. Hen and pig mortality is directly related to outdoor temperature (I.T.G. Porcino, pers. comm.), and rabbit mortality increases in the last part of the summer owing to myxomatosis (pers. obs.). In consequence, the roost might be frequented more often at these times by breeding and non-breeding birds searching for food, such as occurs in other large roosting raptors (Isaacs and Anthony 1987). We believe, however, that this cannot be the only valid explanation, as the availability of food in our study area was extraordinarily high in all seasons. In the village nearest roost 1, there were 26 000 pigs and 51 000 hens which were expected to provide a monthly average of 15 and 153 carcasses, respectively. On the other hand, immigration rate is high during the months May–June before the expected high mortality of livestock and wild rabbit takes place.

In our opinion, the observed dynamics of the largest roost could be in response to 2 factors: 1) changes in relative frequencies in the population of non-breeding birds (adults and immatures); and 2) changes in the breeding status of adults. Spring migration of adult Egyptian Vultures through Gibraltar continues after the start of the reproductive season in Spain (see Cramp and Simmons 1980). For this reason, a progressive increase of adults in the roost in early spring might result from numbers of non-breeding birds, perhaps adults in their first plumage, migrating late. Moreover, the increase in immatures observed in the roost in late spring may also correspond to late migrants since in May and June a great number of immatures can be seen crossing from Africa to Spain (Bergier 1987). On the other hand, peaks observed in the rate of increase of adult vultures coincide with critical periods in the breeding cycle: egg-laying (March–April) and the first month of chick development (June–July). Roosts might receive a number of adults whose breeding attempt had failed. However, this implies that roosts would receive birds from a wide area since the number of roosting adults makes up about 25% of the breeding population of the study area, and frequency of breeding failure in the area is relatively low (Donázar and Ceballos 1988). Further, high numbers of immatures observed in the studied roosts supports our conclusion. The Egyptian Vulture, in common with other large raptors (Brown and Amadon 1968, Hiraldo et al. 1979, Piper et al. 1981) may undergo a high pre-adult mortality, which leads us to conclude that immatures observed in our roosts come from a wide area. This conclusion is reinforced by the very scarce reports on observations of immature birds out of roosts in Spain (J.L. Perea, pers. comm.). It has frequently been claimed that immatures do not return to Europe until acquiring adult plumage (Stresemann, Ridell in Cramp and Simmons 1980, Geroudet 1965).

Results of a radiotelemetry study of 3 adult Egyptian Vultures in the area of roosts 1, 3 and 5 suggest that roosts receive both breeding and non-breeding adults (Donázar and Ceballos 1987, Ceballos and Donázar 1989). Two marked birds were non-breeding birds that depended totally on the roost and neighboring feeding sites. The other radio-tagged adult was a breeding female which only frequented the roost at night. In New World Vulture roosts, the presence of breeding adults from adjacent territories and of non-breeding adults has been reported (Rabenold 1986, 1987). Finally, the appearance during August and September of juveniles recently fledged could be interpreted as the recruitment of family groups as happens in Black Vultures (Rabenold 1986). We did not, however, see any behavior in juveniles (begging, feedings by adults) which would indicate dependence. More probably, roosts are used as rest stops by juveniles during migration. In fact, a young bird we marked rested 1 night in roost 6 after starting migration. The bird's natal territory was 6 km from the roost, and the bird migrated without its parents.

ACKNOWLEDGMENTS

We are grateful to Alejandro Urmeneta and Ignacio García Bello for field assistance; to Fernando Hiraldo who provided guidance throughout this study and revision of the manuscript; to Sanford R. Wilbur, David C. Houston, and Alistair Robertson who provided constructive criticisms of the manuscript; and to Catherine Miller who made the English translation. The study was partially financed by the Instituto Nacional para la Conservación de la Naturaleza (Sección de Recursos Naturales Renovables), and a FPI-grant from the C.S.I.C. to one author (J.A.D.), Project DGJCYT, PB87-0405.

LITERATURE CITED

BAYER, R.D. 1982. How important are bird colonies as information centers. *Auk* 99:31-40.

BERGIER, P. 1987. Les rapaces diurnes du Maroc. Annales du C.E.E.P. no. 3.

——— AND G. CHEYLAN. 1980. Statut, succès de reproduction et alimentation du vautour percnoptère *Neophron percnopterus* en France mediterranéenne. *Alauda* 48:75-97.

BROWN, L. AND D. AMADON. 1968. Eagles, Hawks and Falcons of the world. Country Life Books, London.

CEBALLOS, O. AND J.A. DONÁZAR. 1989. Actividad, uso del espacio y cuidado parental en una pareja de Alimoches (*Neophron percnopterus*) durante el periodo de dependencia de los pollos. *Ecologia* 2:34-45.

CONGOST, J. AND J. MUNTANER. 1974. Presencia otoñal e invernal y concentración de *Neophron percnopterus* en la isla de Menorca. *Misc. Zool.* 3:1-11.

CRAMP, S. AND K.E.L. SIMMONS (EDS.). 1980. The birds of the western Palearctic. Vol. 2. Oxford University Press, Oxford.

DONÁZAR, J.A. AND O. CEBALLOS. 1987. Parámetros reproductores y uso del espacio en el Alimoche (*Neophron percnopterus*). Unpubl. report. I.C.O.N.A., Sección de recursos naturales renovables, Madrid.

——— AND ———. 1988. Alimentación y tasas reproductoras del Alimoche (*Neophron percnopterus*) en Navarra. Ardeola 35:3-13.

FALIU, L., Y. LIGNEREUX AND J. BARRAT. 1980. Identification des poils des mammiferes pyreneens. *Doñana, Acta Vert.* 7:125-212.

GEROUDET, P. 1965. Les rapaces diurnes et nocturnes d'Europe. Delachaux et Niestlé, Neuchatel.

HIRALDO, F., M. DELIBES AND J. CALDERON. 1979. El Quebrantahuesos *Gypaëtus barbatus* (L.). I.C.O.N.A. Monografías 22, Madrid.

IÑIGO, E.E. 1987. Feeding habits and ingestion of synthetic products in a Black Vulture population from Chiapas, New Mexico. *Acta Zool. Mex. (ns)* 22:1-11.

ISAACS, F.B. AND R.G. ANTHONY. 1987. Abundance, foraging, and roosting of Bald Eagles wintering in the Harney Basin, Oregon. *Northw. Sci.* 61:114-121.

MUNDY, P.J. 1982. Comparative biology of southern African vultures. Vulture Study Group, Johannesburg.

PATERSON, R.L., JR. 1984. High incidence of plant material and small mammals in the autumn diet of Turkey Vulture in Virginia. *Wilson Bull.* 96:467-469.

PINTO, M.V. 1980. Estudo morfológico dos pelos dos mamíferos portugueses. Chaves para a sua determinaçao. Actas I reunión Iberoamer. *Zool. Vert.*:629-680.

PIPER, S.E., P.J. MUNDY AND J.A. LEDGER. 1981. Estimates of survival in the Cape Vulture *Gyps coprotheres*. *J. Anim. Ecol.* 50:815-825.

PORTER, R.F., I. WILLIS, S. CHRISTENSEN AND B.P. NIELSEN. 1974. Flight identification of European raptors. T.& A.D. Poyser, Calton, England.

RABENOLD, P. P. 1986. Roost attendance and aggression in Black Vultures. *Auk* 104:647–653.

———. 1987. Recruitment for food in Black Vultures: evidence for following from communal roosts. *Anim. Behav.* 35:1775–1785.

SIEGEL, S. 1956. Non-parametric statistics for behavioral sciences. McGraw-Hill Book Company, New York.

SWEENEY, T.M. AND J.D. FRASER. 1986. Vulture roost dynamics and monitoring techniques in southwest Virginia. *Wildl. Soc. Bull.* 14:49–54.

WARD, P. AND A. ZAHAVI. 1973. The importance of certain assemblages of birds as "information-centres" for food-finding. *Ibis* 115:517–534.

WRIGHT, A.L., R.H. YAHNER AND G.L. STORM. 1986. Roost-tree characteristics and abundance of wintering vultures at a communal roost in south central Pennsylvania. *Raptor Res.* 20:102–107.

Received 20 March 1989; accepted 15 December 1989